

north Pacific passed inland at a high latitude and exerted but little effect on the weather of the Pacific coast states.

During the last decade of the month a series of small storms, some moving southeastward from the Washington coast and others moving inland from off the northern California coast, passed eastward over the southern portion of the district and broke the long drought in California.

Storm warnings were ordered as follows: Northwest warnings at San Francisco on the 11th, and at Point Reyes on the 16th; and southwest warnings from Port San Luis to San Diego on the 20th.

Livestock warnings were issued in eastern Oregon and Idaho on the 14th; and in Nevada, Idaho, eastern Oregon and eastern Washington on the 18th, and 27th. The following commendation of these warnings is extracted from a letter received from the superintendent of the eastern Oregon branch of the Oregon Agricultural College:

"Many thanks for your telegrams relative to changes in weather conditions. This information was immediately given to our stockmen, and I assure you it was appreciated very much."

Frost warnings were issued as follows: 13th, in Oregon, 15th, Oregon and Washington; 16th, northern California; 18th, and 23d, Oregon and Washington; 25th, Oregon and Washington; 27th, northern California; 29th, interior of California; 30th, northern California and Oregon.—*G. H. Willson.*

627.41 (73)

RIVERS AND FLOODS

By H. C. FRANKENFIELD, Meteorologist

Except for the floods of March 28-29 in the upper Potomac River, and on and after March 29 in the Monongahela and Ohio Rivers and their tributaries, no particularly destructive floods occurred in the principal rivers of the United States during March.

The Potomac River flood was caused by a combination of heavy rains with high temperatures that rapidly melted the heavy snow covering that had fallen over the drainage area during the month of March, from 3 to 4 feet remaining in the mountains at the time of the rains and high temperatures. In the North Branch of the Potomac River the flood was the greatest since the memorable flood of June 1, 1869, and in some localities was thought to have at least equaled the latter flood. Many towns were flooded, houses and bridges carried away, highways overflowed and destroyed, and great damage done in many other respects. In the town of Kitzmiller, Md., five lives were lost in the rush of the flood waters, but there were no other fatalities except one in the Shenandoah River near Harrisonburg, Va., and another at Washington, D. C.

The flood was particularly destructive in the vicinity of Cumberland, Md., but fortunately without loss of human life. The following report on the Cumberland flood was prepared by Dr. Harvey H. Weiss, river and cooperative observer and health officer of Cumberland:

During March, 1924, heavy snowfalls occurred throughout western Maryland. During most of the month all roads were blocked with drifts of snow, in some cases 15 to 20 feet high. The mountains were also covered with at least 3 to 4 feet of snow. On the morning of March 29, 1924, the maximum temperature having risen on the 28th to 65°, a heavy rainfall occurred, beginning at about 2 a. m. The rainfall between 2 a. m. and 8 a. m. was 1.63 inches. This rainfall, together with the snow washed down from various mountains, brought down a tremendous amount of water which emptied into the Potomac River, and at

8 a. m., March 29 the water had risen to 8 feet at the Cumberland, (Md.) gage. The reading on the 28th of March was 4 feet 3 inches.

Wills Creek which flows into the Potomac River at Cumberland was out of its banks at 8:30 a. m. At this time the lowlands along the river at Cumberland and also the lowlands of Ridgeley, W. Va., which is opposite Cumberland, were beginning to flood. The Potomac River rose at the rate of 1 foot per hour until 3 p. m. and then the rise was about 1½ foot per hour until 6 p. m., when the river remained stationary for about one hour and then began to recede. The river gage being only able to measure 10 feet, the height from 11 a. m. on was estimated by the observer. According to measurement after the water receded it was found that the river at the gage had reached a height of 19 feet 2½ inches. This reading may be high because of the fact that the water at the bridge may have been turbulent and therefore pushed higher than the actual level.

By 2 p. m. the entire lowland of Cumberland known as the "flats" was covered with 3 feet of water. Wills Creek flooded the main business section of Cumberland to a height of 3 feet. Mechanic Street, one of the main streets of the city, was like a river bed, the water rushing down the street at a great velocity. At 6 p. m. the crest of the flood was reached. By this time telephone, telegraph, and electric wires had been torn away, putting the city in complete darkness. Half of the west side of Cumberland was under 5 feet of water, and the center of the city contained about 4 feet of water. Most of the paving was washed away. The water had entirely receded at 5 a. m. on March 30 and cleaning up began immediately. There was no loss of life in Cumberland because of the flood. The property loss including railroad damage and bridges washed away was about \$4,000,000 at a conservative estimate. From all information available the water on March 29, 1924, was 2½ feet higher than at any previous time in the history of Cumberland.

The South Branch of the Potomac River was not so high, yet the flood was one of considerable proportions, and with the flood from the North Branch, caused a severe flood below the junction of the North and South Branches, overflowing all lowlands, tearing out banks of the Chesapeake & Ohio Canal in many places, flooding railroad tracks, and doing much other damage of a miscellaneous character as far as the mouth of the Shenandoah River, except in the vicinity of Harpers Ferry, W. Va., where the damage done was negligible, although the river reached a stage of 20.7 feet on March 30, or 2.7 feet above the flood stage. The rise in the Shenandoah River did not reach flood proportions, and as a consequence the flood below Harpers Ferry was not dangerous, although there was considerable overflow at various places.

The damage done by the flood probably amounted to as much as \$6,000,000 exclusive of railroad losses. Highway roads and bridges were reported to have been damaged to the extent of about \$1,500,000.

Warnings were first issued for the flood on March 29, but the early interruption of telegraph service above Cumberland prevented the receipt of accurate information, and the warnings were therefore not as effective as they would otherwise have been.

The conditions antecedent to the floods in the Monongahela River of West Virginia and in the streams tributary to the Allegheny River in Pennsylvania were very similar to those that caused the Potomac floods, although they were not nearly so destructive. The crest stage at Pittsburgh, Pa., was 29.2 feet, or 7.2 feet above the flood stage, on March 30, and the damage done in the Pittsburgh river district amounted to about \$1,000,000. However, the value of property saved through the accurate and timely flood warnings was reported to have been about \$10,000,000.

The flood waters continued down the Ohio River, and at the close of the month the river had passed the flood stage of 40 feet at Point Pleasant, W. Va., at the mouth of the Great Kanawha River. The crest stage at

Parkersburg, W. Va., was 40.2 feet, or 4.2 feet above flood stage, at 10 a. m., April 1, and at Point Pleasant 44.5 feet, or 4.5 feet above flood stage, at 8 a. m., April 2. These crest stages were also very accurately forecast, and there were no losses or damage of consequence.

Report on the flood in the Ohio River and its tributaries below the mouth of the Great Kanawha River will appear in the MONTHLY WEATHER REVIEW for April, 1924.

The floods in the Muskingum, Hocking, and Scioto Rivers of Ohio also occurred on March 29, 30 and 31. They were well forecast and passed off with very little damage.

In the Miami River there was some overflow of lowlands unprotected by levees, but very little damage. According to reports the flood protection system took care of all surplus water exactly as had been calculated.

The Santee River of South Carolina was in moderate flood during virtually the entire month, and there was also a small flood in the Saluda River of the same State on March 21 and 22. Both floods were forecast at the proper times and the losses as reported amounted to only \$3,465. The value of property saved through the warnings was reported at \$17,900.

In the Tombigbee and Black Warrior Rivers of Alabama there were floods of considerable proportions on March 6 and 7 and a second crest of 52.8 feet, or 13.8 feet above flood stage, at Demopolis, Ala., on March 14 and 15. The river at Demopolis had been above flood stage since February 27, and the bottom lands from that place to the mouth of the river were inundated.

Statements as to losses from this flood were very indefinite, and totaled only \$1,650. They were probably somewhat greater. The value of property saved through the warnings that were issued was reported as \$24,250.

Floods in the Pearl and West Pearl Rivers of Mississippi and Louisiana were moderate and caused but little damage. The usual warnings were issued.

The flood of March 29-31 in the Maumee River of Ohio was caused by the heavy rains of that period. Warnings were issued promptly and no material damage resulted. The rise in the upper Grand River of Michigan was inconsequential.

The only important flood in the west Gulf district occurred in the Trinity River of Texas during the latter part of the month and the river was still in flood at the close of the month from Trinidad southward. There had also been a previous flood over the extreme lower portion of the river which continued from April 1 to 8, inclusive. At Dallas, Tex., the river reached a stage of 34.0 feet on March 25, or 9 feet above the flood stage. Warnings were issued frequently and as a result livestock and other movable property were salvaged, and as crops had not yet been planted, the losses were negligible. The reported value of property saved through the warnings was \$30,000.

An ice gorge that formed during the night of March 7-8 in the Missouri River near Blencoe, Iowa, about 65 miles above Omaha, Nebr., continued for about 24 hours, and between 3,000 and 4,000 acres of valuable farm lands were inundated and several families were compelled to leave their homes.

River and station	Flood stage	Above flood stages—dates		Crest	
		From	To	Stage	Date
ATLANTIC DRAINAGE					
Potomac:	Feet			Feet	
Cumberland, Md.	8	29	30	19.2	29
Harpers Ferry, W. Va.	18	30	31	20.7	30
Washington, D. C.	8	31	31	8.0	31
Cape Fear: Elizabethtown, N. C.	22	(1)	2	23.4	1
Peedee: Mars Bluff, S. C.	17	1	6	19.0	3
Santee:					
Rimini, S. C.	12	(1)	10	15.2	3
		14	16	12.8	15
		21	31	14.4	26
Ferguson, S. C.	12	(1)	(1)	13.7	4-5
Saluda: Chappells, S. C.	14	(1)	(1)		
		21	22	14.8	21
EAST GULF DRAINAGE					
Coosa: Lock No. 4, Lincoln, Ala.	17	8	8	17.1	8
Tombigbee:					
Aberdeen, Miss.	33	6	7	33.8	6
Lock No. 4, Demopolis, Ala.	39	(1)	22	52.8	14-15
Black Warrior: Lock No. 10, Tuscaloosa, Ala.	46	(1)	(1)		
		6	7	53.6	7
Chickasawhay: Enterprise, Miss.	21	(1)	(1)	22.2	Feb. 29
Pearl: Jackson, Miss.	20	1	23	26.8	7-9
West Pearl: Pearl River, La.	13	3	9	13.6	5-6
		12	29	14.1	23-24
GREAT LAKES DRAINAGE					
Maumee:					
Fort Wayne, Ind.	15	29	(1)	19.2	31
Napoleon, Ohio	10	30	(1)	10.8	31
St. Joseph: Montpelier, Ohio	10	6	7	12.0	6
		29	(1)	12.1	30
Auglaize: Defiance, Ohio	10	30	(1)	12.0	31
Grand:					
Eaton Rapids, Mich.	5	5	7	5.2	6-7
Grand Ledge, Mich.	7	6	8	7.2	7
MISSISSIPPI DRAINAGE					
Stony Creek: Johnstown, Pa.	10	29	30	16.0	29
Kiskiminetas: Saltsburg, Pa.	8	30	30	11.8	30
Monongahela:					
Lock No. 15, Houtt, W. Va.	22	29	29	26.6	29
Lock No. 10, Morgantown, W. Va.	25	29	29	26.8	25
Lock No. 7, Martin, Pa.	30	29	30	38.9	29
Lock No. 4, Pennsylvania	31	30	30	41.4	30
Cheat: Rowlesburg, W. Va.	12	29	29	12.3	29
Youghiogheny:					
Confluence, Pa.	10	29	30	19.0	29
West Newton, Pa.	20	30	30	25.3	30
Ohio:					
Pittsburgh, Pa.	22	30	31	29.2	30
Lock No. 2, Coraopolis, Pa.	26	30	31	29.8	30
Dam No. 6, Beaver, Pa.	30	30	(?)	39.8	30
Dam No. 12, near Wheeling, W. Va.	36	31	(?)	38.4	31
Marietta, Ohio	33	30	(?)	38.9	31
Parkersburg, W. Va.	36	31	(?)	39.4	31
Dam No. 19, near Tallman, W. Va.	39	31	(?)		
Dam No. 22, W. Va.	42	31	(?)		
Point Pleasant, W. Va.	40	31	(?)		
Muskingum:					
Zanesville, Ohio	25	30	30	25.8	30
McConnellsville, Ohio	22	30	31	25.0	30
Marietta, Ohio	36	31	(?)		
Tuscarawas:					
Coshocton, Ohio	8	30	31	12.3	30
Gnadenhutten, Ohio	10	6	7	11.3	6
		30	(?)		
Walhonding:					
Walhonding, Ohio	8	29	30	12.6	29
Hocking:					
Athens, Ohio	17	30	31	17.8	30
Scioto:					
LaRue, Ohio	11	29	30	14.0	29
Prospect, Ohio	10	29	31	11.4	30
Bellpoint, Ohio	9	30	30	10.2	30
Circleville, Ohio	10	30	31	16.3	30
Chillicothe, Ohio	16	30	31	22.9	31
Oleontangy: Delaware, Ohio	9	29	29	10.0	29
Miami:					
Sidney, Ohio	12	29	29	12.6	29
Middletown, Ohio	15	31	(?)	15.4	31
Mad: Springfield, Ohio	10	29	29	11.5	29
Stillwater: Pleasant Hill, Ohio	13	29	29	15.0	29
Wabash:					
Bluffton, Ind.	12	31	31	12.0	31
Lafayette, Ind.	11	25	(?)		
Terre Haute, Ind.	16	30	(?)		
White, East Fork: Seymour, Ind.	10	31	(?)		

1 Continued from last month.

2 Continued at end of month.

3 Below flood stage at 8 a. m., Mar. 1.

River and station	Flood stage	Above flood stages—dates		Crest	
		From	To	Stage	Date
White, West Fork:	<i>Feet</i>			<i>Feet</i>	
Anderson, Ind.	12	30	30	15.2	30
Noblesville, Ind.	14	30	31	16.4	30
Elliston, Ind.	19	30	31	22.0	31
Edwardsport, Ind.	14	30	(¹)		
Tennessee: Riverton, Ala.	33	7	10	34.1	8
Illinois:					
Morris, Ill.	13	30	(¹)		
Peru, Ill.	14	(¹)	(¹)		
Henry, Ill.	7	1	(¹)		
Peoria, Ill.	16	5	23	18.5	3-11
Havana, Ill.	14	27	(¹)		
Beardstown, Ill.	12	(¹)	(¹)		
Sulphur:					
Ringo Crossing, Tex.	20	18	23	23.0	21
Finley, Tex.	24	23	26	24.9	25-26
North Platte: North Platte, Nebr.	5	(¹)	1	5.3	{ Feb. 28- 29 W
Grand: Chillicothe, Mo.	18	30	(¹)		
WEST GULF DRAINAGE					
Sabine:					
Logansport, La.	25	(¹)	1	25.2	1
Bon Wier, Tex.	20	1	3	20.3	2
Trinity, Elm Fork: Carrollton, Tex.	7	18	18	7.6	18
		20	22	7.9	20
Trinity:					
Dallas, Tex.	25	16	25	34.0	21
Trinidad, Tex.	28	20	(¹)	37.2	26
Long Lake, Tex.	40	31	(¹)		
Liberty, Tex.	25	(¹)	8	26.6	2-4
		15	31	26.1	21-22
Guadalupe: Victoria, Tex.	16	(¹)	1	19.4	Feb. 29

¹ Continued from last month.² Continued at end of month.

MEAN LAKE LEVELS DURING MARCH, 1924

By UNITED STATES LAKE SURVEY

[Detroit, Mich., Apr. 4, 1924]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes ¹			
	Superior	Michigan and Huron	Erie	Ontario
	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>
Mean level during March, 1924:				
Above mean sea level at New York.....	601.07	578.69	571.26	244.88
Above or below—				
Mean stage of February, 1924.....	-0.26	-0.02	-0.01	+0.03
Mean stage of March, 1923.....	-0.40	-0.27	+0.26	+0.14
Average stage for March, last 10 years.....	-0.67	-1.28	-0.38	-0.60
Highest recorded March stage.....	-1.25	-4.26	-2.59	-2.63
Lowest recorded March stage.....	+0.41	-0.27	+0.43	+0.58
Average relation of the March level to—				
February level.....		+0.1	+0.2	+0.2
April level.....		-0.3	-0.6	-0.7

¹ Lake St. Clair's level: In March, 1924, 573.50 feet.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS MARCH, 1924

By J. B. KINCEB

Much of March was unseasonable cold in all except the extreme northern portions of the country, and rainfall was frequent in most of the principal agricultural districts, though the total falls were considerably less

than normal from the Ohio and middle Mississippi Valleys southward. The cool weather was generally unfavorable for spring work, and the preparation of soil and the seeding of crops were considerably delayed. In the Southern States the first few days of the month and the last week were favorable for field work, but otherwise the continued wet soil and low temperatures were decidedly unfavorable.

The planting of cotton was very backward at the close of the month, though some planting had been done in the southern portions of the east Gulf States and in the Florida Peninsula. Planting in Texas was confined to the southern third of the State, and germination and progress of the early planted was generally poor because of the unfavorable weather. There was considerable corn planted the latter part of the month in the South, and at the same time much ground was prepared in central districts, but the preparation for planting was behind the average season.

The weather was generally favorable for wheat in the States between the Mississippi River and the Rocky Mountains, and the crop continued in good condition, especially in the Plains States, where soil moistures was unusually favorable. This crop showed some greening up in the Ohio Valley States at the close of the month, but on the whole the weather was rather unfavorable in that area. There was frequent alternate freezing and thawing, and heavy winterkilling resulted in many localities, especially in the central and southern portions of Indiana and Illinois and in Kentucky. It was fairly favorable for work in the spring wheat belt, although the latter part of the month was stormy and cold and but little work could be accomplished. It was generally unfavorable for seeding oats in the interior valley States and this work became much behind. Early seeded oats made fairly good progress in the Southwest, however, and improvement was noted in most other portions of the South.

Meadows and pastures showed general improvement in the Southeastern States and rain the latter part of the month greatly benefited grass lands in California, where severe drought had prevailed. There was considerable stormy weather in the Rocky Mountain districts which, together with the cold, was rather unfavorable for stock, but at the same time the precipitation was beneficial for the range, though more rain was needed in parts of the Southwest.

There was more or less damage to fruit in west Gulf districts about the 10th, and at the same time some slight frost damage was reported from the far northwestern States. There was considerable frost injury to early fruit also in Arizona, and to peaches and apricots in the north Pacific States during the week ending March 25. On the whole, however, the continued cool weather was favorable for fruit interests and no widespread harm had occurred at the close of the month. Trees were backward in budding out and blooming, which tended to lessen the danger of damage from frost. There was some damage to truck crops in the southeast by heavy rains, and low temperatures were very unfavorable for planting and replanting truck in the Southern States.